Spatio -Temporal Change in Land Use Pattern of Sonarpur Block, South 24 Parganas District, West Bengal

Ph. D. Synopsis

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1. A Brief Introduction of the Research Topic

Land is an essential natural resource. It helps to survive and reflect the growth of settlement and social cultural development. Changing land use pattern is a continuous process by which the formal space of an area converted into functional space. Many changes occur into land use pattern due to continuous growth of population and process of urbanization. Spatio-temporal changes of land use pattern become more important to understand the changes of a place over time.

The growth of cities over the last century has been rapid due to the growing population and shift of rural population to urban areas. In the developing world, cities have expanded haphazardly beyond their administrative boundaries many a times due to lack of coordination in urban planning. While the core area of city continues to be an area of dense population, it is the peripheral area that has absorbed the growing population. This has resulted in changing land use pattern both within the city and its boundaries.

The spatio-temporal transformation of land use and land cover (LULC) is a subject of critical importance in the realm of environmental science, geography, and urban planning. The dynamic interplay between natural processes and human activities has led to profound alterations in landscapes across the globe. Among the myriad regions experiencing such transformations, the Sonarpur Block in the South 24 Parganas District of West Bengal, India, stands as a microcosm of these changes, epitomizing the complex evolution of land use and land cover in a rapidly urbanizing and developing context.

This exploration into the spatio-temporal change in land use and land cover of Sonarpur Block delves deep into the region's past, the drivers of its transformations, and the implications for its present and future. Through a comprehensive review of existing literature, geospatial data, and on-ground observations, this study endeavors to shed light on the intricate tapestry of LULC changes in this unique corner of West Bengal, ultimately contributing to a broader understanding of the evolving landscapes that define our modern world.

2. State of the Art

Professor Dudley Stamp, a pioneer in the field of Urban Geography, analyzed land use with respect to urban areas. He established Land Utilization Survey of Britain, in 1930s and created a map of Great Britain’s land use. It is very important to describe land use patterns in

a systematic and regional manner, and shifting land use patterns can be used to explain why resource usage is becoming more intensive and how man's interactions with land are changing. Changing land use pattern is dynamic and varies at different spatial and temporal scales [(1)]. The land transformation caused by the high population growth rate, which creates changes to economic and infrastructural development of an area [(2)].

Conversion of land categories into non built up to built-up, and other categories are natural in urbanization. The spatio-temporal changes in land use explain the areal differentiation, urban growth trajectory and future land use with population projection [(3)]. The intensive explanation and areal differentiation maps and diagrams and geospatial data are help to understand the changing form of land dynamicity [(4)]. Large urban areas are rapidly expanding, especially in developing nations like China, India, and certain African cities as well as the Asian giants. Cities were unable to completely accommodate their populations inside their bounds due to the exponential rise of the human population. [(5)]

According to Zadbagher and Becek (2018) (6), the pattern of LULC is the result of both anthropogenic and natural activity, and it is impacted by local socioeconomic conditions (7). An understanding of the LULC in a region is essential for planning and managing land and related resources (8). Anthropogenic activities have surpassed natural influences in recent decades, changing LULC (9). However, it might be challenging to determine if LULC changes are the result of socio-economic or natural factors (10).

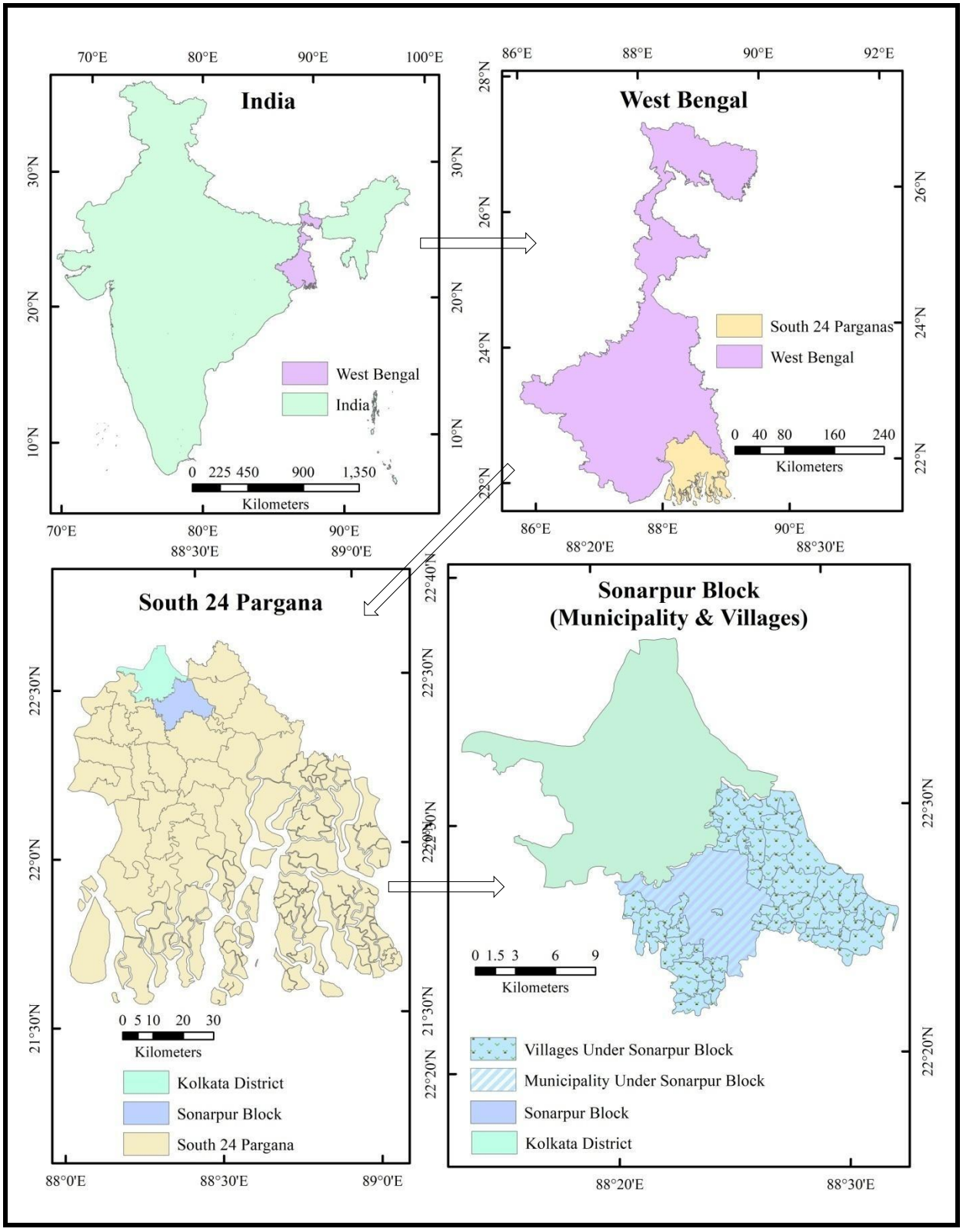
According to Goldblatt et al. (11), complex fluctuations in LULC patterns have been seen throughout the previous century, and these changes are the main reason for the environmental system's changes (12).

To maintain a sustainable society, the consequences of LULC changes on the environment, ecological, and socioeconomic fields must be carefully considered. Change detection in LULC is an important factor to consider when planning and managing a region (13), and quantifying and tracking this change is essential to understanding the processes that occur at the planet's land surface (14). The spatial and temporal patterns of LULC and its changes can be examined using LULC mapping (15). A future prediction of LULC areas is essential in understanding future change can occur (16). This can help decision makers and planners consider appropriate management Measures for developing and implementing practices for reducing negative affect (17).

Study Area

The study area Sonarpur Block of South 24 parganas district is located along the southeastern fringe area of the Kolkata Municipal Corporation (KMC), proved to be a suitable area to absorb spill over population of the mega city Kolkata. Sonarpur block extends between 22° 21' 51.696" N to 22° 31' 20.064"N and 88° 20' 22.596" E to 88° 32' 37.104"E. It has an average elevation of 9 meters (30 ft) and a geographical area of 120.63 sq.k.m. The Block area consists with 75mouzas, along with them 65 inhabited villages, 7 census towns and 1municipal area. The block is bounded by Baruipur on south, Canning -I, and II on East, Bhangar - I and II situated on north and northeast, Bishnupur -I on the western part, and shares the North West boundary with Kolkata Municipal area. Kolkata is a metropolitan city located at the eastern bank of the Hoogli River. In the present day the population of Kolkata metropolitan area is growing at a fast rate, so the expansion of the metropolis is affecting the adjacent rural land, thereby leading to a transformation of fringe areas.

LOCATION MAP OF THE STUDY AREA



3. Problems to be investigated

A. How the expansion of Kolkata has led to the development of Sonarpur block?
B. Whether landuse and landcover pattern has changed uniformly in the last five decades?
C. To determine the trend, nature, rate, location and magnitude of landuse and landcover change.
D. To predict the landuse and landcover will change the in the near future.

4. Objective of the investigation and motivation

1) To analyse the land use land cover transformation of the Sonarpur Block area of last five decades viz. from 1981 to 2021.

2) To assess the changing demographic characteristics of Sonarpur in last five decades.

3) To examine the temporal and spatial dynamics of land use and land cover, including inter-change and intra-changes among different landuse and landcover categories within the study area.

4) To predict the forthcoming landuse and landcover patterns in the Sonarpur Block.

5. Research Hypothesis

※ **First Hypothesis**

H_0: There has been no change in physical land use/land cover pattern in Sonarpur area in last five decades.

Ha: There has been a significant change of land use/land cover pattern in Sonarpur area in last five decades.

Second Hypothesis

H_0: There has been no change in the demographic characteristics of Sonarpur block in last five decades.

Ha: There has been a significant change in demographic characteristics of Sonarpur block in last five decades.

Third Hypothesis

H_0: There would be no significant change of landuse and landcover in the upcoming future.

Ha: There would be significant change of landuse and landcover in the upcoming future.

6. Research design and methodology

The research design is a conceptual framework within which the research work will be completed to achieve the research goal. It is the blueprint for collection, measurement and analysis of data. The present study will be based on secondary data. And the present research work will be done into three basic steps, i) Data acquisition, ii) Data processing and iii) Data representation.

DATA	DATA ACQUISITION	DATA PROCESSING	DATA REPRESENTATION
Satellite Imagery	Landsat Imagery data (temporal data of 1981, 1991, 2001, 2011, 2021 yrs) Landsat archive of the United States Geological Survey (USGS) website (https://glovis.usgs.gov/). (https://earthexplorer.usgs.gov/).	**Image processing:** Geo metrically and Geo Referencing through ground truth verification. Satellite image correction like noise correction, to enhance the visual clarity & interpretability. **Image classification** : Automatically categorised all pixel in an image into land cover land use classes. Commonly used supervised classifier. Different Classes like i) Built-up area, ii) Water body, iii) Vegetation, iv) Bare land, v) Fallow land, and vi) Agricultural land categories etc will be used. Over all accuracy will be assessed **Change detection:** from multi temporal satellite imageries Post classification comparison (PCC) should be used.	Different maps will be prepared from various Remote sensing & GIS software to represent the Land Use/Land Cover transformation, dynamicity and many other analyses. After collecting, processing, and analysing all data, report writing will be conducted. Analysis will be interpreted and it will compare and validate with various previous research. Remote Sensing Softwares like, QGIS-3.14, ArcGIS 10.4, Erdas Imagine 2014, TerreSet 2020 and Fragstat along with
Topographical map	Toposheet numbers are from old series of 79 B/7 and very few portion of 79 B/11. https://www.surveyofindia.gov.in/		
Secondary data	The secondary data will be obtained from various governmental and quasi-governmental sources like Census of India, Survey of India, District head office, Sonarpur, Municipal Corporation office and BLRO office etc.		

		Accuracy in change detection would be calculated from error matrix, confusion matrix etc. Kappa co-efficient techniques could be used for to test interrater reliability or to assess the effectiveness **Patch analysis**: Different multi temporal and multi spatial patch could be analysed **Future prediction model**: Suitable model to predict future LULC will be prepared. .	SPSS 25, MS office 2019 etc.

Tentative Chapters

- Introduction
- *CHAPTER* – 1: Geographical Background of the Sonarpur Block
- *CHAPTER* – 2: Factors and Natural principle of Landuse classification.
- *CHAPTER* – 3: Spatio Temporal Changes of Land use of Sonarpur Block.
- *CHAPTER* – 4: Landuse changes and its impact on human activities of Sonarpur Block
- *CHAPTER* – 5: Change detection and future prediction of landuse and landcover.
- *CHAPTER* – 6: Government initiatives of land resources management and results of land reforms in the block.
- CHAPTER – 7: Landuse planing strategy for the development of land resources in the block.
- Summary and conclusion

7. Source of data and Tools to be used in the data collection

- Secondary data collection will be gathered through Government and non-governmental reports, Departmental reports, Census data, Statistical handbooks, Books, Research publications, Journals, Published Ph.D thesis etc.

- Collection of Satellite imageries for Landsat satellite image data which are freely accessed from the Landsat archive of the United States Geological Survey (USGS)

websites area (https://glovis.usgs.gov./) (https://earthexplorer.usgs.gov/), Survey of India's Toposheets. Germin e Trex 10 GPS. Etc.

- Data processing will be done through different Remote Sensing Softwares like, QGIS-3.14, ArcGIS 10.4, Erdas Imagine 2014, TerreSet 2020 and Fragstat along with SPSS 25, MS office 2019 etc.

8. Analysis of data

- The spatio-temporal changes in land use should be analysed through the satellite image processing, image classification, change detection of multi temporal data set.
- Over all accuracy assessment, error emission, image differences, image regression, composite analysis, and post classification comparison, Kappa co-efficient analysis etc. suitable techniques would be done into the imagery analysis part.
- To measure land use dynamics, essential tools like, urban-rural gradient view, break point analysis, cross tabulation matrix, transition matrix, spatial matrix which is applicable could be used.
- Different suitable statistical techniques could be used for representation and to analyse the demographic data.

9. Significance of the study

- The study of land use dynamicity from last five decade signifies the expansion of urbanization and transformation of built-up area over the time and space.
- The rate of change of agricultural land, water bodies, wetland, etc. and transport network over study area should be analysed.

12.Its relevance to present day problem and needs to the society

The study area falls under the second most populous district of West Bengal and is located in the fringes and densely populated areas of Kolkata city. Areas where the urbanization process is more than others are facing some problems.

- Problems due to urbanization can be identified. If there is any transformation of the land, its causes and consequences will be understood.
- Which factors are more effective in this area of variability can be analysed.
- What is the effective development plan for the area, and what will be the remedial measures to rehabilitate the problems identified

13. Contribution to the existing knowledge

- This study should help to identify the factors which are responsible for land use change in Sonarpur fringe area.
- The changing land use pattern for a long period of five decades will be make better understanding for improvement plan for urban fringe area.
- The present research will guide the way in the future how to take care of the environment in the right development method.

14. Future work

- A comparative study on development pace and characteristics between Sonarpur and other fringe area of Kolkata would be done in future.
- Future study would be revealed why and what are the causes of different pace of urbanization in census towns under the study area.
- The quality of life of the people which are change in faster mode are to discussed
- Land use maps from different temporal imageries can be used to study the environmental change for near future of this area.

Reference

1) Cihlar. J (2000) Land cover mapping of large areas from satellites: Status and research priorities. April 2000 International Journal of Remote Sensing 21(6-7):1093 - 1114

2) Majumdar, S. (2020). Assessment and detection of land cover changes in the southern fringe of Kolkata using remotely sensed data. *Geography, Environment, Sustainability*, *13*(4), 121-132.

3) Thandar, S. (2012). Analysis of Spatio-temporal changes of urban land use using remote sensing and GIS: A case study of Bhubaneswar City, Odisha. *Dagon University Research Journal*, *4*, 19-29.

4) Mandal, J., Ghosh, N., & Mukhopadhyay, A. (2019). Urban growth dynamics and changing land-use land-cover of megacity Kolkata and its environs. *Journal of the Indian Society of Remote Sensing*, *47*, 1707-1725.

5) Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology in society*, *28*(1-2), 63-80.

6) Zadbagher, E., & Becek, K. (2018). Modeling land use/land cover change using remote sensing and geographic information systems: Case study of the Seyhan Basin, Turkey. Environmental Monitoring and Assessment, 190(8), 1–15

7) Tendaupenyu, P., Hilary, C., Magadza, D., & Murwira, A. (2017). Changes in landuse/landcover patterns and human population growth in the Lake Chivero catchment, Zimbabwe. Geocarto International, 32(7), 797–811. https://doi.org/10.1080/10106049.2016.1178815

8) Mishra, V., Rai, P., & Mohan, K. (2014). Prediction of land use changes based on land change modeler (LCM) using remote Journal of the Indian Society of Remote Sensing (November 2022) 50(11):2175–2191 2189 123sensing: A case study of Muzaffarpur (Bihar), India. Journal of the Geographical Institute Jovan Cvijic, SASA, 64(1), 111–127. https://doi.org/10.2298/ijgi1401111m

9) Abdu, H. A. (2019). Classification accuracy and trend assessments of land cover-land use changes from principal components of land satellite images. International Journal of Remote Sensing, 40(4), 1275–1300. https://doi.org/10.1080/01431161.2018.1524587

10) Vanderpost, C., Ringrose, S., Kgathi, D., & Matheson, W. (2007). The nature and possible causes of land cover change (1984–1996) along a rainfall gradient in southeastern Botswana. Geocarto International, 22(3), 161–183. https://doi.org/10.1080/10106040701202002

11) Goldblatt, R., Deininger, K., & Hanson, G. (2018). Utilizing publicly available satellite data for urban research: Mapping built-up land cover and land use in Ho Chi Minh City, Vietnam. Development Engineering, 3(March), 83–99. https://doi.org/10.1016/j.deveng.2018.03.001

12) Abdulkareem, J. H., Pradhan, B., Sulaiman, W. N. A., & Jamil, N. R. (2019). Prediction of spatial soil loss impacted by long-term land-use/land-cover change in a tropical watershed. Geoscience Frontiers, 10, 389–403

13) Fathizad, H., Rostami, N., & Faramarzi, M. (2015). Detection and prediction of land cover changes using Markov chain model in semi-arid rangeland in western Iran. Environmental Monitoring and Assessment. https://doi.org/10.1007/s10661-015-4805-y

14) Midekisa, A., Holl, F., Savory, D. J., Andrade-pacheco, R., Gething, W., Bennett, A., & Sturrock, H. J. W. (2017). Mapping land cover change over continental Africa using Landsat and Google Earth Engine cloud computing. PLoS ONE, 12(9), e0184926. https://doi.org/10.1371/journal.pone.0184926

15) Ullah, S., Ahmad, K., Sajjad, R. U., Abbasi, A. M., Nazeer, A., & Tahir, A. A. (2019). Analysis and simulation of land cover changes and their impacts on land surface temperature in a lower Himalayan region. Journal of Environmental Management, 245, 348–357. https://doi.org/10.1016/j.jenvman.2019.05.063

16) Waseem, M., Halmy, A., Gessler, P. E., Hicke, J. A., & Salem, B. B. (2015). Land use/land cover change detection and prediction in the north-western coastal desert of Egypt using Markov-CA. Applied Geography, 63, 101–112. https://doi.org/10.1016/j.apgeog.2015.06.015

17) Parthasarathy, K. S. S., Saravanan, S., Deka, P. C., & Devanantham, A. (2020). Assessment of potentially vulnerable zones using geospatial approach along the coast of Cuddalore district, East coast of India. ISH Journal of Hydraulic Engineering, 28(S1), 422–432. https://doi.org/10.1080/09715010.2020.1753250